

## CONSERVATION PRACTICE STANDARD

### FENCE

(Feet)

### CODE 382

#### DEFINITION

A constructed barrier to animals, or people.

#### PURPOSES

This practice may be applied as part of a conservation management system to facilitate the application of conservation practices that treat the soil, water, air, plant, animal, and human resource concerns in order to:

- Implement a prescribed grazing plan and provide better distribution of grazing livestock.
- Protect grazing animals from hazardous areas such as sinkholes, poisonous plants, and roads.
- Protect protection of streams, wetlands, and other water bodies to increase or protect water quality.
- Provide protection of new seedlings or plantings.
- Regulate access to areas by people or animals.

#### CONDITIONS WHERE PRACTICE APPLIES

This practice applies on any area requiring control or exclusion of livestock, wildlife, predators, or people.

#### CRITERIA

#### General criteria for all purposes

Fencing material, type, and design shall be of a quality and durability that meets the intended management objectives.

Use 12 ½ gauge wire for the exterior fence and a smaller gauge wire can be used for the interior.

Locate fences to facilitate maintenance. When possible, avoid irregular terrain, water crossings, and narrow corners. Where applicable, clear right of ways should be established and maintained to facilitate fence construction and maintenance.

The purpose of the fence shall be factored into determining the type of fence to be constructed. Sheep and hogs may require woven wire, horses may require wooded or other non-injurious types of fence, cattle may be contained with electrified wire, and chain link fence may be required to control people access to areas.

All fences shall consist of acceptable designs to meet the intended purpose and lifespan of the practice.

Height, number and spacing of wires will be installed to facilitate control and management of animal(s) or people of concern.

Height, size, spacing, and type of posts will be used that best provides the needs for the style of fence required.

Selection and design of fences shall adhere to manufacturer's recommendations to ensure suitability to use and site conditions.

All fence design shall comply with federal, state, and local regulations, easements, and access agreements.

The landowner shall obtain all necessary permits prior to construction and installation.

### **Additional criteria to implement prescribed grazing management**

Improve resource management by locating fences to separate areas with differences in forage seasons of growth and palatability, use, topography, or production potential.

Pasture/paddock divisions shall be consistent with grazing needs as projected by a grazing plan developed under Pennsylvania Conservation Practice Standard *Prescribed Grazing*, (Code 528A).

Locate fences to control livestock access to water and handling facilities.

Any permanent fencing for grazing livestock should allow flexibility to facilitate implementation of the prescribed grazing plan and permit land management activities such as nutrient application, pest control, forage harvest, and other appropriate practices.

Locate fences to facilitate livestock management, handling, watering, and feeding.

### **CONSIDERATIONS**

Place warning signs on electric fences a minimum of 300 feet apart.

When possible, install fences across slopes to improve grazing distribution, rainfall infiltration, and reduce soil erosion.

Consider the movement needs of wildlife when locating fences. Fence wire height may require adjustments to repel predators or avoid entanglement.

When using electrified fences to control livestock, a training area should be used to condition livestock to fences.

### **PLANS AND SPECIFICATIONS**

Plans and specifications are to be prepared for specific sites based on this standard.

Plans and specifications for installing fences shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve all of its intended purposes.

Safety – is a concern when constructing electric fences. The following are guidelines of safety to adhere to:

1. Do not allow guide or line wires to contact any power lines.
2. Do not erect wires or ground wires near overhead power lines, telephone wires, or radio antennas. It is illegal to cause interference.
3. Install energizers inside a building when possible. Energizers need not be attached to a power pole. All power supply lines should comply with local electrical codes.
4. All energizers must be connected to a separate grounding system. Never attach energizer to other farm related grounding devices (i.e. electric panels ground rods, lightning rods on buildings, houses, barns, etc.). Fence charger ground rods need to be at least 6 feet away from grounding rods that are not part of the fencing system.
5. Only one energizer should be installed onto a fence line.
6. Where there is public access to the fence, both interior and exterior fence, warning signs should be placed at a minimum of 300 feet apart.
7. Warn all children that electric fencing is being used and let neighbors know where and how to shut off the current.
8. Install lightening arrestors and chokes to protect fence.

### **OPERATION AND MAINTENANCE**

The designer shall provide an Operation and Maintenance plan to guide the landowner in assuring the intended service life of the fence. The O&M plan shall include, but not be limited to the following items, as applicable to the type of fence being used. Additional guidance shall be included, specific to the type of fence and its use.

Regular inspection of fences shall be part of an ongoing management program. Inspection of fences after storm events is needed to facilitate the function of the intended use of the fence.

Retain and properly discard all broken fencing material and hardware. All necessary precautions should be taken to ensure the safety of construction and maintenance crews.

Check all fence systems for proper functionality and maintain tension to design specifications. Where electric fences are used, periodically check output of charger with a voltmeter.

Annual clearing of weeds and brush under and near the fence systems will prolong life expectancy. Maintenance and repairs shall be performed in a timely manner to maintain the desired control.

For streams or water crossings where the depth of the stream is less than 1/3 the height of the fence, the fence will run uninterrupted. For streams of greater depth end the main fence at the top of the streambank on each side with an appropriate end assembly. From separate posts driven next to the end posts, construct a separate section of fence across the watercourse that shall be de-energized during high flow or flooding conditions. The only tie between the main fence and the section spanning the watercourse shall be a single electrical connection.

## FENCE

### CONSTRUCTION SPECIFICATIONS

#### 1. Scope

The work shall consist of furnishing materials and installing all components of the fence as outlined in this specification and the drawings.

Construction shall be performed in a manner that meets the intended management objectives.

Safety is a primary concern. Wire that is over-stretched may break and recoil. Eye and hand protection should be worn. Follow all manufacturers' safety precautions for handling and installing fencing materials.

Wire should be attached on the side of posts that will receive the greatest pressure from animals. Wires will be placed on the outside of posts on curves.

Locate fences to facilitate maintenance. When possible, avoid irregular terrain, water crossings, and narrow corners. Where applicable, clear right of ways should be established and maintained to facilitate fence construction and maintenance.

#### 2. Materials

##### Fence

Barbed Wire – will consist of not less than 4 wires and shall be a minimum of 12 ½ gauge with a 4-point barb spaced no more than 6 inches apart.

Woven Wire – will consist of a high tensile woven wire with a minimum of gauge 12 ½. Vertical wire spacing shall not be more than 12 inch. Height depends on the class of livestock to be controlled.

Wooden Boards – The boards should be 1 inch thick and at least 6 inches in width (1 X 6) with lengths of 16 feet wherever possible.

Polywire/ Polytape – Polywire and polytape shall have a minimum of 6 stainless steel, copper, or aluminum strands running through the fabric.

Chain Link – shall be a minimum of 4 foot high, 9 gauge wire woven into a 2 inch diamond shape in which the individual pickets are helically wound and interwoven to form a continuous link fabric. Hot-dipped galvanized material will be 2 ounces of zinc coating per square foot and should be evenly distributed over the entire fabric as per ASTM A392, Class II. The following minimum breaking strength shall apply: 1290 pounds and be 9 gauge (0.148"). The fabric shall be twisted, top and bottom. All chain link fence fabric will carry the manufacturer's identification tag. High Tensile Wire\* shall be new, smooth, and meet or exceed the following specifications:

1. 1000 lbs. breaking strength.
2. type III galvanized.
3. 16 gauge wire minimum.

4. 250 lbs. minimum tension per wire with in-line strainer.

#### **Fasteners\*.**

Nails\* – for board fence, nails should be galvanized and not less than 3 1/2 inches long

Insulators – The type and size of insulators shall meet the requirements to fasten electric fence materials to a post.

Staples\* - Staples should be of 9 gauge galvanized wire with a minimum of 1 1/4" length.

Clips\* - The type and size of clips shall meet the manufacturer's requirements to attach them to the wire.

#### **Posts.**

Wood - shall have all bark removed and be black locust, cedar, or preservative pressure treated (PPT). PPT lumber shall be treated with chromated copper arsenate (cca), type A, B, or C or ammoniated copper quat (acq)\*

1. Line and brace posts shall be 6 1/2 feet long and have a minimum 4 inch diameter on the small end.
2. Corner and gate posts shall be a minimum of 8 feet long and have a minimum 6 inch diameter on the small end.

**\*When using ACQ treated wood, special treated metal hardware is needed due to the corrosive nature of this material. (Suggestions are stainless steel or post hot-dipped galvanized hardware and wire).**

Fiberglass - rods shall have a minimum diameter of 0.375", be of adequate length for the design fence height, plus have a minimum embedded depth of 6" with deeper sets in dips or low spots in the fence line, and be of smooth finish.

Steel Rods\* - rods shall have a minimum diameter of 0.359", be of adequate length for the design fence height, plus have a minimum embedded depth of 6" with deeper sets in dips

or low spots in the fence line, and have an aluminum paint finish.

Steel\*- posts shall be hot-dipped galvanized with at least 2 ounces of zinc coating per square foot per ASTM 669. Painted posts shall be clean of loose scale with one or more coats of weather resistant paint applied.

Chain Link will have all steel posts and shall be set in cylindrical concrete foundations. Holes are to be 10 inches or more in diameter for line posts, and 12 inches or more in diameter for all other posts.

1. Corner and gate posts:
  - a. angle iron = 2.5" x 2.5" x 0.25",
  - b. tubular pipe = 2.5" OD
2. Line posts (1.3 lbs. per foot) shall be studded or punched "T", "U", or "Y" shaped with anchor plates.
3. Brace posts:
  - a. angle iron = 2" x 2" x 0.25",
  - b. tubular pipe = 1.63" OD
4. Steel posts for swing gate assemblies shall be of the following:

#### **Double Swing**

<u>Gates</u>	<u>OD Pipe</u>	<u>Weight Per Linear Ft</u>
0 - 12 ft.	2.5"	3.1 lbs.
12 - 24 ft.	4.0"	6.2 lbs.
24 - 38 ft.	6.6"	18.9 lbs.
38 - 46 ft.	8.6"	24.7 lbs.
46 - 60 ft.	10.7"	31.2 lbs.

5. Braces shall be 2" x 2" x .25" angle iron or 1.62" outside diameter pipe or tubular steel 8 to 10 feet long.

Trees – can be used as a post for non-electrified fence when its position in the line of fencing makes its use as a post the only practical alternative. A nail board must be used.

#### **Electric fence.**

When using electricity to divide areas, poly-wire/polytape or steel wire is acceptable. At least one wire will be charged by an energizing unit. Cut out switches shall be installed to turn-off electricity from going to grazing units

that are not being used and/or for trouble shooting.

Energizers – should have the following features:

1. Low impedance
2. Safety paced fuse to prevent over pulsing.
3. Solid state circuitry with at least 5,000 to 6,000 volt output.
4. Indicator light or system to show unit is pulsing .
5. Built in lightening arrestor.
6. Proper grounding as recommended by the manufacturer.

Insultube – shall be of acceptable thickness to withstand long term exposure to ultra-violet light.

Lightening Protection – a lightening choke or arrestor and or surge protection devices shall be placed between the energizing unit and the fence system to lessen the impact of natural energy surges.

### **Grounding**

1. Non-electrical fences should be grounded at least every 1,000 feet, closer depending on the soil drainage class. Ground rods should be driven not less than 3 feet into the ground and be galvanized steel .75" in diameter or larger.
2. Electric fences should have ground rods placed near the energizing unit that meet or exceed the manufacturer's recommendations. The minimum acceptable ground rod depth is 6 feet, (see Attachment 3).

### **Brace assemblies.**

A brace is a device, as in a supporting beam, that steadies or holds something together, (see Attachment 4).

#### Wooden

1. Single Braces are needed for 2 to 6 strands of high tensile fence. (see Attachment 4).

2. Double span assemblies shall be used for 7 or more strands of wire. (see Attachment 4).
3. Combination single and double brace spans shall be used on rolling land with a lot of curvature. Braces should be placed every as per manufacturer's recommendation.
4. Brace assemblies are needed for Woven Wire, barbed wire, and any combination of woven, barbed, and high tensile wire.

Each single brace assembly component will have 2 brace pins that consist of galvanized steel rods\* 3/8" X 9" and 3/8" X 4" long\*.

#### Steel

Steel galvanized pipe brace of the same length can replace a wooden brace. Diameter of galvanized steel brace should be a minimum of 2 inches in diameter.\*

### **Bend assemblies.**

When constructing wire fence along a curve or contour, post spacing is determined by the degree of bend. Curvature is measured by placing 3 stakes, spaced 14 feet apart along the fence line. A string is then stretched between stake 1 and stake 3. The measurement taken is from stake 2 to the string.

Spacing of posts are determined as follows:

#### **Curvature post spacing.**

- 0 – 4 inches 14 feet
- 4 – 7 inches 12 feet
- 7 – 9 inches 10 feet
- 9 – 15 inches 8 feet
- 15 – or more inches 6 feet

Posts are to be placed equal distant from each other.

### **Tension.**

1. For exterior wire fences, the tension should be maintained per manufacturers specification. An in-line strainer shall be on each of the strand, with a

spring tension indicator on one of the strands for monitoring purposes.

2. For interior wire fences, tension should be adequate to maintain the desired height and prevent wire from sagging between posts.

#### Wire spacing.

Height of constructed fence fabric is determined by the species intended to control. The recommended heights for exterior, interior, electric and non-electric fences are shown in Table 1, 2, and 3.

#### MINIMUM HEIGHT GUIDELINES

<u>SPECIES</u>	<u>MINIMUM HEIGHT</u>
Deer	94 inches
Horses	48 inches
People	48 inches
Cattle	46 inches
Goats	42 inches
Sheep	36 inches
Swine	36 inches

1. When using wire for **exterior** fences, the spacings in Table 1 are given as a guideline. Adjustments to the spacing may be made according to the manufacturer's recommendation.
2. When installing exterior fence for goats a combination of high tensile woven wire and high tensile smooth wire shall be used. The woven wire shall be 32 inches tall and 2 strands of 12 ½ gauge electric high tensile wire shall be installed 6 " and 12 " above the woven wire. An additional single strand of 12 ½ gauge electric high tensile wire shall be installed, offset, on the inside of the wove wire 12 " to 18" off the ground.
3. Fencing for Ag Waste Storage structures and ponds will vary. Chain Link fence will be used on top of concrete structures where animals or humans could readily access the top of the structure (for details see end for Chain

Link Fence Specification). Ag Waste Ponds can be fenced with high tensile fencing. A minimum of 8 strands of 12½ gauge wire with 2 strands electrified, on 15 ft post spacings, or 12 ½ gauge woven wire 42 " high, with 1 strand 12 ½ gauge barbed wire or 1 strand of 12 ½ gauge electrified high tensile wire at 48" of height. For streams or water crosses where the depth of the stream is less than 1/3 the height of the fence the fence will run uninterrupted for streams of greater depth.

4. For streams or water crossings where the depth of the stream is less than 1/3 the height of the fence, the fence will run uninterrupted. For streams of greater depth end the main fence at the top of the streambank on each side with an appropriate end assembly. From separate posts driven next to the end posts, construct a separate section of fence across the watercourse that shall be de-energized during high flow or flooding conditions. The only tie between the main fence and the section spanning the watercourse shall be a single electrical connection.

The following guidelines are provided for the minimum number of wires on **interior** electric fences.

#### MINIMUM INTERIOR WIRE GUIDELINES

<u>SPECIES</u>	<u>NO. OF WIRES</u>
Cattle	1
Cattle w/ calves	2
Horses	2
Sheep	2
Swine	2
Goats	3
Cattle (hard to control)	3

Recommendations of wire spacing for interior electric fences are given in Table 3. Adjustments can be made on wire spacings as per manufacturers recommendations.

#### Post Spacing.

Post spacing is determined by several factors such as number of strands, type of wire, soil type, terrain, and animals to be fenced. The following is a guideline for high tensile fence post spacing. Batten or stay spacing is specified. If no battens are used, spacing will be that of rolling terrain.

#### High Tensile Wire/Electrified Smooth Wire & Polywire Exterior Fence

Number wires	<u>No. Battens</u>	<u>With Battens</u>
1 - 3	30'	40' w/ battens @ 20' max
4 - 5	20'	30' w/ battens @ 15' max
6+	16 ½'	20' w/ battens @ 10' max

#### Interior Fence\*\*

Number wires	0 to 8% <u>Flat</u>	<8% & Various <u>Rolling</u>
1 – 2	50'	40'
3 - 4	35'	30'
5 – 6	25'	20'
7 +	20'	16 ½'

Post spacings can be greater based on manufacturer's recommendations as long as livestock are contained and the lifespan of the fence is guaranteed.

\*\*Battens may be used on interior fence to maintain wire spacing, but post spacing will not change.

Board, woven wire, and exterior barbed wire post spacing shall be 16 ½' maximum. Interior barbed wire post spacing shall be 20' maximum. Post spacing on chain link fence shall be 10' maximum or as specified on construction details or drawings.

## **INSTALLATION**

Posts shall be established by driving, auguring, or hand digging. Fill material used in backfilling oversized dug holes, shall be clean soil material with little rock and hand tamped in 6 inch lifts. Cement can be used on oversized dug holes, instead of tamped, clean soil backfill. When used, it shall be of a Portland mix type and sloped at the top to provide positive drainage. Braces are horizontal posts placed between two posts in a brace assembly.

If using locust posts, nail in a diamond shape wherever possible to keep the wood from splitting.

Corner and gate posts shall be set a minimum of 4 feet deep below the soil surface.

Line and brace posts shall be set a minimum of 2 ½ feet deep below the soil surface.

#### Splices and Knots\* (see Attachment 2)

Staples should be driven at an angle to the grain and not tight against the wire (see Attachment 1).

For steel and notched fiberglass or plastic posts, clips should be hooked over the notch and wrapped around the line wire tightly to secure wire to the post (see Attachment 1).

Predrill boards to prevent splitting.

When wooden boards are used the surface shall be painted or treated with a wood preservative material for rot protection.

## **OPERATION AND MAINTENANCE**

Regular inspection of fences shall be part of an ongoing management program. Inspection of fences after storm events is needed to facilitate the function of the intended use of the fence.

Check all fence systems for proper functionality and maintain tension to design specifications. Where electric fences are used, periodically check output of charger with a voltmeter.

Annual clearing of weeds and brush under and near the fence systems will prolong life expectancy. Maintenance and repairs shall be per-

formed in a timely manner to maintain the desired control.

**ADDITIONAL CONDITIONS**

## CONSTRUCTION SPECIFICATION

### 382C - CHAIN LINK FENCE

#### 1. SCOPE

The work shall consist of furnishing materials and installing all components of the chain link fence as described in this specification and the drawings.

#### 2. MATERIALS

Fence fabric, posts, top rails, braces, gates and accessories shall conform to the requirements of this specification. Materials shall be as follows except as otherwise specified in Section 8.

Fabric: 2-inch mesh, g-gauge, minimum weight of zinc coating 1.8 ounces per square foot. (Double dipped galvanized).

Posts: See Pipe Criteria Table, page PA-382C-SP2.

Top Rail: See Pipe Criteria Table, page PA-382C-SP2.

Braces: Same as Top Rails.

Gates: Frame -See Pipe Criteria Table, page PA- 382C-SP2.  
Interior Braces -Same as top rail.

#### 3. DIMENSIONS

The fence shall have a minimum height of four feet or as shown on the drawings or otherwise specified in Section 8.

The length of the fence shall be as shown in the drawings or as specified in Section 8.

#### 4. INSTALLING FENCE POSTS

Line posts shall be placed at intervals not exceeding eight feet measured from center to center of adjacent posts unless otherwise specified on the drawings or in Section 8.

Posts shall be set in concrete a minimum of 12 inches.

All posts shall be capped immediately after installation.

Other installation details shall be as shown on the drawing or specified in Section 8.

#### 5. INSTALLING WIRE FABRIC

Fencing fabric shall not be stretched until at least three days after the posts are set in concrete walls or five days after the posts are set in concrete backfill.

The fabric shall be stretched taut and securely fastened, by means of 9 gage tie clips, to the posts at intervals not exceeding 15 inches and to the top rails or tension wires at intervals not exceeding two feet. Care shall be taken to equalize the tension on each side of each post.

#### 6. INSTALLING GATES

Gate frames shall be fabricated and hung so that they sag no more than one percent (1%) of the gate width.

**PIPE CRITERIA  
For  
CHAIN LINK FENCE**

<b>Outside Diameter (Inches)</b>	<b><u>Top Rail &amp; Gate Frame</u></b>	<b><u>Line Post</u></b>	<b><u>End &amp; Gate Post</u></b>
Trade Size	1 5/8	2	2 ½
Nominal Pipe Size	1 1/4	1 ½	2
Actual Size	1.660	1.900	2.375
<b>Standard Pipe (Schedule 40)</b>			
Wall Thickness (Inches)	0.112	0.145	0.154
Weight (lb/ft)	1.82	2.72	3.65
Zinc Coating (oz/ft <sup>2</sup> )	1.8	1.8	1.8
<b>High Strength Pipe (Min. 50,000 psi Yield Strength)</b>			
Wall Thickness (Inches)	0.065	0.090	0.130
Weight (lb/ft)	1.107	1.74	3.12
Zinc Coating (oz/ft <sup>2</sup> )	0.9	0.9	0.9

NOTE: Outside diameter requirements are the same regardless of pipe material. Pipe material must be either Standard Pipe (Schedule 40) or High Strength (Minimum 50,000 psi Yield Strength) meeting the wall thickness, weight, and zinc coating requirements shown in the table for that type of pipe.

## **7. MEASUREMENT AND PAYMENT**

Method 1 Payment shall be made at the contract lump sum price. Such payment shall constitute full compensation for all labor, equipment, tools, material and all other items necessary and incidental to the completion of the work.

Method 2 Payment shall be made to the nearest foot of installed length of fence, including gates. Such payment shall constitute full compensation for all labor, equipment, tools, material and all other items necessary and incidental to the completion of the work.

All methods Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the work to which it is made subsidiary in Section 8.

## **8. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:**

TABLE 1. EXTERIOR **NON-ELECTRIC** SMOOTH WIRE FENCE SPACING

TYPE	STRAND	WIRE SPACING FROM THE BOTTOM IN INCHES	HEIGHT
Cattle(feed lot)	10	10 - 4 - 4 - 4 - 5 - 5 - 5 - 5 - 5 - 5	52"
Horses	10	6 - 4 - 4 - 4 - 5 - 5 - 5 - 5 - 5 - 5	48"
Cattle + calves	8	4 - 5 - 5 - 5 - 6 - 6 - 7 - 8	46"
Cattle	6	14 - 5 - 6 - 6 - 7 - 8	46"
Sheep	6	5 - 5 - 5 - 5 - 8 - 8	36"
Swine	6	4 - 5 - 5 - 6 - 8 - 8	36"

TABLE 2. EXTERIOR **ELECTRIC** SMOOTH WIRE FENCE SPACING

TYPE	STRAND	WIRE SPACING FROM THE BOTTOM IN INCHES	HEIGHT
Cattle(feed lot)	7	10 - 6 - 6 - 6 - 8 - 8 - 8	52"
Horses	6	10 - 8 - 8 - 8 - 8 - 6	48"
Cattle + calves	5	10 - 8 - 8 - 10 - 10	46"
Cattle	4	10 - 12 - 12 - 12	46"
Sheep	5	6 - 6 - 8 - 8 - 8	36"
Swine	5	6 - 6 - 8 - 8 - 8	36"

TABLE 3. **INTERIOR ELECTRIC** FENCE SPACING

NUMBER OF WIRES	WIRE SPACING FROM THE BOTTOM IN INCHES*	HEIGHT
1	30(+)	30"
2	16(-) - 16(+)	32"
3	12(-) - 10(+) - 14(+)	36"
4	12(-) - 10(+) - 8(-) - 10(+)	40"
5	10(-) - 8(-) - 8(+) - 8(-) - 10(+)	44"

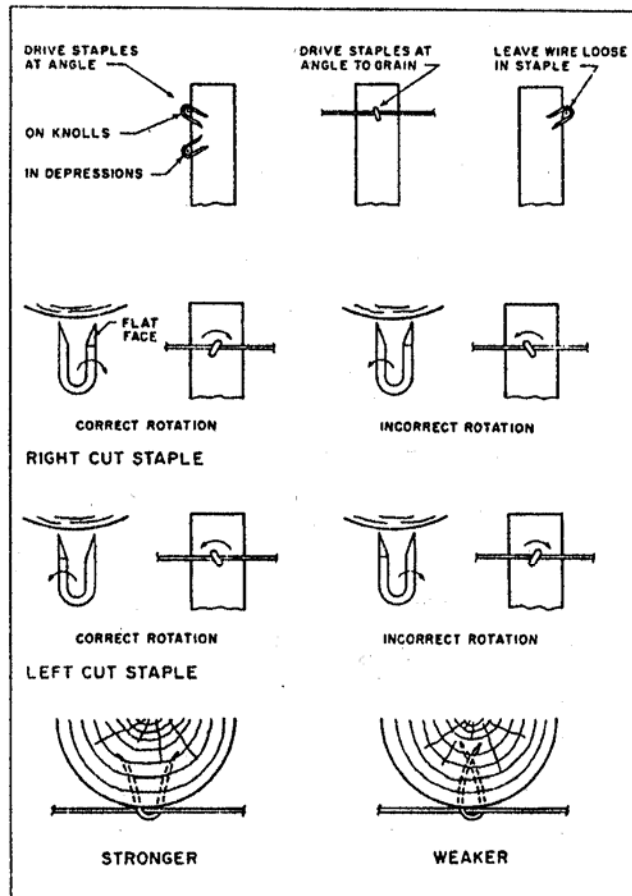
\* Suggested Charging Sequence:

(+) = charged wire

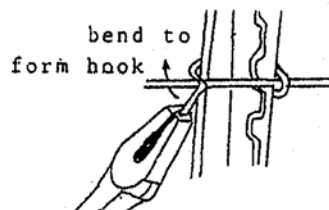
(-) = ground wire

## **ATTACHMENT 1 - STAPLES AND CLIPS**

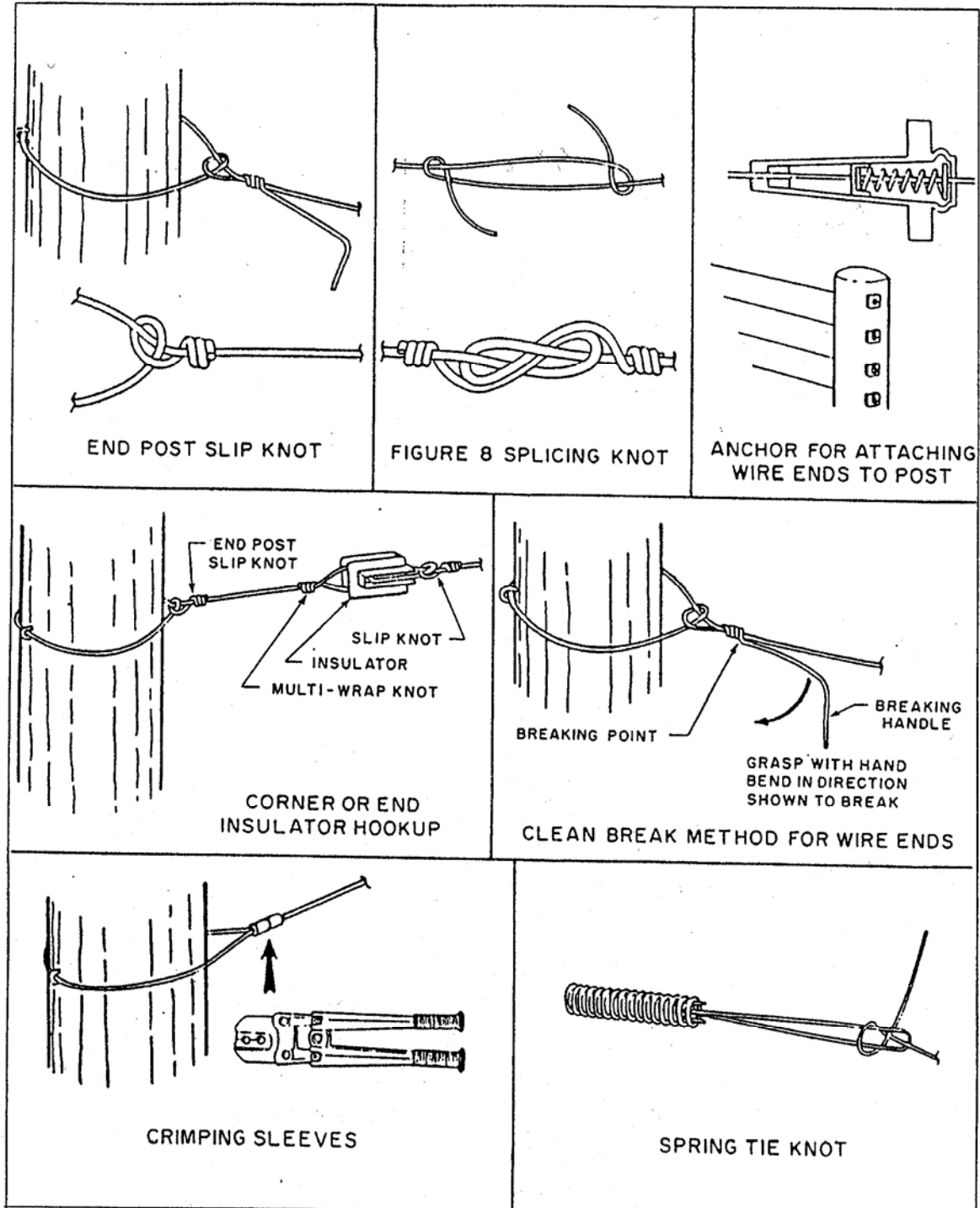
### **Staples for Wooden Posts**

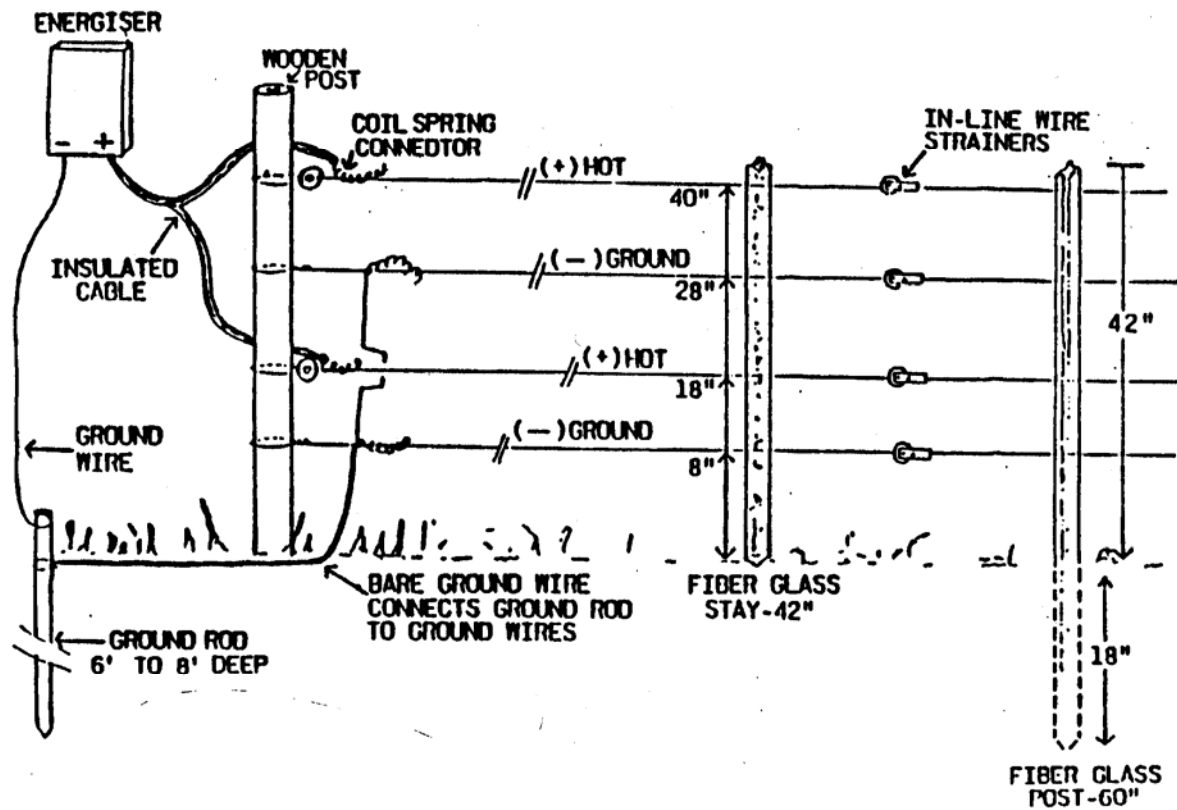


### **Clips for Steel and Notched Fiberglass/Plastic Posts**



**ATTACHMENT 2 - SPLICES AND KNOTS**



**ATTACHMENT 3 - TYPICAL 4 WIRE HOT/GROUND SYSTEM<sup>1/</sup>**

1/ This drawing does not indicate how to construct the corner brace. It will be constructed the same as for regular fences except steel pipe will not be used.

# ATTACHMENT 4 - BRACE ASSEMBLIES

